

This listing of claims will replace all prior versions of claims in this Application.

Listing of Claims

Claim 1. (Currently Amended) A method for electrolytic copper plating on a substrate comprising the steps of providing an electrolytic copper plating solution, and contacting the electrolytic copper plating solution with ozone, wherein the electrolytic copper plating solution comprises a compound comprising the formula of $-X-S-Y-$, wherein X and Y are independently chosen from hydrogen atom, carbon atom, sulfur atom, nitrogen atom, and oxygen atom, and X and Y may be the same only when they are a carbon atom, and wherein a compound of the structure $-X-S-$ in the electrolytic copper plating solution is controlled in the range of 1.0 $\mu\text{mol/L}$ or lower.

Claim 2. (Currently Amended) The method of claim 1, wherein the compound comprising the formula $-X-S-Y-$ is chosen from compounds of formulas (1) to (8)

(1) $M-SO_3-(CH_2)_a-S-(CH_2)_b-SO_3-M$;

(2) $M-SO_3-(CH_2)_a-O-CH_2-S-CH_2-O-(CH_2)_b-SO_3-M$;

(3) $M-SO_3-(CH_2)_a-S-S-(CH_2)_b-SO_3-M$;

(4) $M-SO_3-(CH_2)_a-O-CH_2-S-S-CH_2-O-(CH_2)_b-SO_3-M$;

(5) $M-SO_3-(CH_2)_a-S-C(=S)-S-(CH_2)_b-SO_3-M$;

(6) $M-SO_3-(CH_2)_a-O-CH_2-S-C(=S)-S-CH_2-O-(CH_2)_b-SO_3-M$;

(7) ~~$A-S-(CH_2)_a-SO_3-M$~~ $X-S-(CH_2)_a-SO_3-M$; and

(8) ~~$A-S-CH_2-O-(CH_2)_a-SO_3-M$~~ $X-S-CH_2-O-(CH_2)_a-SO_3-M$;

wherein M is chosen from a hydrogen atom and an alkali metal; X is chosen from a) a hydrogen atom, b) an alkyl group containing 1 – 10 carbon atoms, c) an aryl group, d) a linear or cyclic amino group containing 1 – 6 nitrogen atoms, 1 – 20 carbon atoms, and multiple hydrogen atoms, or e) a hetero cyclic group containing 1 – 2 sulfur atoms, 1 – 6 nitrogen atoms, 1 – 20 carbon atoms, and multiple hydrogen atoms; and a and b are independently an integer of 3 – 8.

Claim 3. (Original) The method of claim 1, wherein the compound comprising the formula $-X-S-Y-$ is present in the electrolytic copper plating solution in the range of 0.1 – 100 mg/L.

Claim 4. (Canceled)

Claim 5. (Original) The method of claim 1 wherein the substrate is chosen from a printed circuit board and a wafer.

Claim 6. (Original) The method of claim 1 wherein the substrate comprises through holes or via holes.

Claim 7. (Original) The method of claim 1 further comprising the steps of contacting the substrate with the electrolytic copper plating solution and applying sufficient current density to deposit copper on the substrate.

Claim 8. (Currently Amended) A method of treating an electrolytic copper plating solution comprising the step of contacting the electrolytic copper plating solution with ozone, wherein the electrolytic copper plating solution comprises a compound comprising the formula of $-X-S-Y-$, wherein X and Y are independently chosen from hydrogen atom, carbon atom, sulfur atom, nitrogen atom, and oxygen atom, and X and Y may be the same only when they are a carbon atom wherein a compound of the structure $-X-S-$ in the electrolytic copper plating solution is controlled in the range of 1.0 $\mu\text{mol/L}$ or lower.